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Two new species of *Pseudecheneis*, rheophilic catfishes (Teleostei: Sisoridae) from Nepal

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Abstract

Two new species of sisorid catfish of the genus *Pseudecheneis* are described from tributaries of the Ganges River in Nepal: *Pseudecheneis crassicauda* and *P. serracula*. *Pseudecheneis crassicauda* can be distinguished from congeners by a unique combination of 38–39 vertebrae, caudal peduncle depth 6.0–6.6% SL, eye diameter 7.5–8.3% HL, length of adipose-fin base 20.3–24.3% SL, pelvic fins reaching the base of the first anal-fin ray, and the presence of pale spots on the body. *Pseudecheneis serracula* can be distinguished from congeners in having a unique combination of 36–38 vertebrae, strongly elevated neural spines of the last 2–3 preanal and first 6–7 postanal vertebrae, length of adipose-fin base 26.8–30.4% SL, pelvic fins reaching the base of the first anal-fin ray, and the presence of pale spots on the body.

Key words: glyptosternines, Ganges River drainage, South Asia

Introduction

Rheophilic catfishes of the sisorid genus *Pseudecheneis* Blyth, 1860 occur in the headwaters of major river drainages throughout South and Southeast Asia. A member of the Glyptosterninae (a group distributed from the Caucasus to China), *Pseudecheneis* is easily diagnosed from other glyptosternines by a thoracic adhesive apparatus consisting of a series of transverse ridges (laminae) separated by grooves (sulcae) (de Pinna, 1996; Roberts, 1998), an adaptation to life in fast-flowing waters. Five species of *Pseudecheneis* are considered valid here, viz. *P. sulcata* (M'Clelland, 1842), *P. paviei* Vaillant, 1904, *P. immaculata* Chu, 1982, *P. sulcatoides* Zhou & Chu, 1992, and *P. sympelvica* Roberts, 1998. *Pseudecheneis sulcata* is known from the Ganges, Brahmaputra, Salween and Irrawaddy River drainages, *P. paviei* from the Red River drainage, and *P. immaculata*, *P. sulcatoides* and *P. sympelvica* from the Mekong River drainage.

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While comparing material identified as *Pseudecheneis sulcata* from the Ganges River drainage in Nepal (collected by DRE) and the Brahmaputra River drainage in India (collected by HHN) for a phylogenetic study of the Sisoridae, differences were observed that suggested the material from Nepal belongs to two undescribed species, which are described below.

Materials and methods

Measurements were made point to point with dial calipers, and data recorded to tenths of a millimeter. Counts and measurements were made on the left side of specimens whenever possible. Subunits of the head are presented as proportions of head length (HL). Head length and measurements of body parts are given as proportions of standard length (SL). Measurements follow those of Ng & Rainboth (2001). An asterisk after a particular meristic count indicates value for the holotype. Osteological data were obtained from radiographs.

Material examined in this study is deposited in the following institutions: Natural History Museum, London (BMNH), California Academy of Sciences, San Francisco (CAS), Collection of Maurice Kottelat, Cornol (CMK), University of Kansas Natural History Museum, Lawrence (KU), Muséum National dHistoire Naturelle, Paris (MNHN), Department of Zoology Collection of Vertebrates, Oklahoma State University, Stillwater (OSUS), University of Michigan Museum of Zoology, Ann Arbor (UMMZ), and Zoölogisch Museum Amsterdam (ZMA).

Pseudecheneis crassicauda sp. nov. (Fig. 1)

Pseudecheneis sulcatus (non M'Clelland, 1842) Shrestha, 1981: 197, Fig. 91 (in part); 1994: 62, Fig. 97 (in part).

Type material. Holotype: BMNH 1958.9.1.8, 103.7 mm SL; Nepal: Mewa Khola (River), Dhankuta District, 27°0'N 87°20'E; J. C. Getley, date unknown.

Paratypes: BMNH 1958.9.1.9 (1), 56.8 mm SL; data as for holotype. BMNH 1970.12.14.230 (1), 136.8 mm SL; Nepal: Mewa Khola (River), Sanghu; K. Hyatt, 7 December 1961.

Diagnosis. *Pseudecheneis crassicauda* is distinguished from *P. paviei* and *P. sympelvica* in having an elongate body with 38–39 vertebrae (vs. short body with 33–35 vertebrae) and from *P. sympelvica* in having separate (vs. fused) pelvic fins. It differs from other congeners in having a deeper caudal peduncle (6.0–6.6% SL vs. 3.8–5.5) and (except for *P. immaculata*) a smaller eye (7.5–8.3% HL vs. 8.8–12.8). It further differs from *P. immaculata* in having a shorter adipose-fin base (1.5–2.0 times of anal-fin base vs. more

than 2.0; 20.3–24.3% SL vs. 27.7) and the presence (vs. absence) of pale spots on the body, and from *P. sulcata* in having pelvic fins that reach (vs. do not reach) the base of the first anal-fin ray.

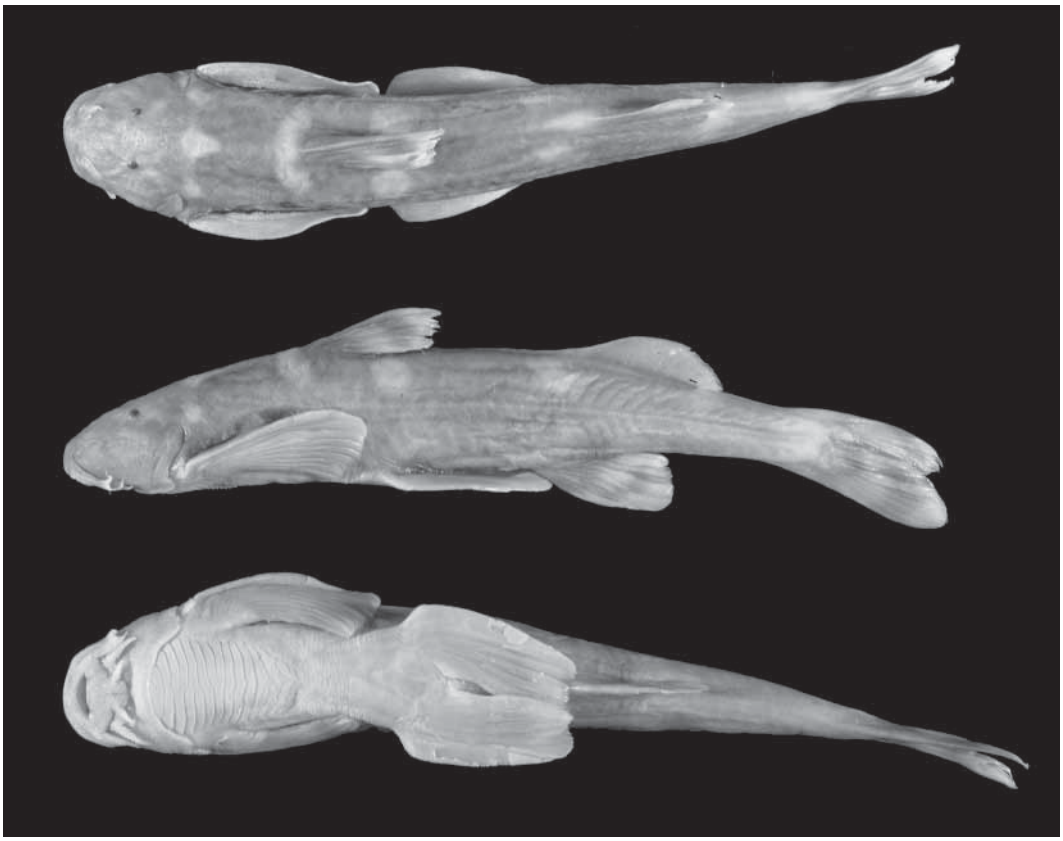

FIGURE 1. *Pseudecheneis crassicauda*, BMNH 1958.9.1.8, holotype, 103.7 mm SL; Nepal: Mewa Khola. Dorsal, lateral and ventral views.

Description. Morphometric data as in Table 1. Head and abdominal region narrow and strongly depressed. Dorsal profile rising gently from tip of snout to origin of dorsal fin, then almost horizontal or sloping very gently ventrally to end of caudal peduncle. Ventral profile horizontal to anal-fin base, then sloping very gently dorsally to end of caudal peduncle. Caudal peduncle long and moderately compressed. Anus and urogenital openings located at posteriormost extent of pelvic fin. Skin smooth, tuberculate in some areas. Lateral line complete and midlateral. Vertebrae 19+19=38 (1), 19+20=39* (1) or 20+19=39 (1).

Head acutely rounded when viewed from above. Gill openings moderate, extending from posttemporal region to base of first pectoral-fin element. Head covered with thick, tuberculate skin. Ventral surface of head with unculiferous collar on distal margin of branchiostegal membrane immediately anterior to thoracic adhesive apparatus.

Thoracic adhesive apparatus consisting of 12–15 transverse ridges (laminae) separated by grooves (sulcae); ridges frequently not meeting at midline of adhesive apparatus. Adhesive apparatus extending from immediately posterior to collar on distal margin of branchiostegal membrane to level of last pectoral-fin ray.

Barbels flattened, and in four pairs. Maxillary barbel with ventral surface densely covered with papillae, and pointed tip; barbel extending about two-thirds of distance between its base and base of first pectoral-fin element. Distal half of barbel attached to snout via large, thin flap of skin. Nasal barbel with small flap of thin skin fringing posterior margin and extending midway to distance between posterior nares and anterior orbital margin. Inner mandibular-barbel densely covered with papillae; origin close to midline, extending to collar on distal margin of branchiostegal membrane. Outer mandibular barbel originates posterolateral of inner mandibular barbel, extending to level of anterior orbital margin. Eye small and almost rounded, subcutaneous and located on dorsal surface of head.

Mouth inferior, with moderately broad, thin papillate lips. Rictal lobe large and papillate. Premaxillary tooth band not exposed when mouth is closed. Premaxillary teeth short and conical, arranged in irregular rows on a moderately large quadrangular patch. Dentary teeth long, thin and somewhat rounded at tip; arranged in irregular rows on two separated, roughly triangular patches.

Dorsal-fin origin located at point through anterior third of body. First and second dorsal fin-ray elements not ossified, bearing i,6 (3) rays, and fin margin straight. Adipose fin with short base, approximately 1.5 to 2 times of anal-fin base length; located in middle third of postdorsal region. Adipose fin margin gently convex; posterior end deeply incised. Caudal fin forked, with i,7,7,i (2) or i,7,8,i* (1) principal rays; procurrent rays symmetrical and extend only slightly anterior to fin base. Anal fin with short base extending approximately equal to adipose fin-base length and iv,6 (1), v,7 (1) or v,8* (1) rays. Anal fin margin almost straight.

Pelvic-fin origin at vertical through second or third dorsal fin-ray base. Pelvic fin greatly enlarged, extending to base of first anal-fin ray. Anterior fin margin strongly convex, first element broadened and with regular striae on ventral surface; with i,5 (3) rays. Pectoral fin greatly enlarged and with convex anterior margin, reaching to just beyond pelvic-fin base. First element not ossified, broadened and with regular striae on ventral surface; fin with i,12 (1) or i,13* (2) rays.

Coloration. In 70% ethanol: chestnut brown on dorsal and lateral surfaces of head and body, fading to very light brown on ventral region. Dorsal surface of head and body with distinctive series of small, very light brown spots and bands: one ovate spot on base of first dorsal-fin ray, and another pair on each side of body immediately posterior to last dorsal-fin ray; one band on each side of body at adipose-fin origin, and another on caudal peduncle at base of caudal fin. Dorsal and anal fins hyaline, with brown base and brown subdistal band; brown coloration of base and subdistal band connected to each other at anterior third of fin. Adipose fin light brown, with lighter color around distal edge,

especially at posterior end of fin. Caudal fin brown, with hyaline distal margin. Dorsal surfaces of pectoral and pelvic fins brown, ventral surfaces light yellow. Maxillary and nasal barbels brown dorsally and light yellow ventrally.

TABLE 1. Biometric data for *Pseudecheneis crassicauda* (n=3).

	Holotype	Range	Mean±SD
%SL			
Predorsal length	34.8	34.5–34.9	34.7±0.21
Preanal length	59.0	59.0–63.9	61.9±2.59
Prepelvic length	41.4	35.1–41.4	38.4±3.16
Prepectoral length	17.3	16.4–18.7	17.5±1.16
Length of dorsal-fin base	11.6	9.7–12.4	11.2±1.39
Anal-fin length	11.7	11.7–14.3	12.9±1.31
Pelvic-fin length	23.0	22.4–23.0	22.6±0.35
Pectoral-fin length	25.0	22.6–28.2	25.3±2.81
Caudal-fin length	21.4	20.1–23.1	21.5±1.50
Length of adipose-fin base	20.3	20.3–24.3	21.8±2.18
Dorsal to adipose distance	24.5	15.8–24.5	20.8±4.48
Post-adipose distance	16.6	15.1–16.6	15.7±0.78
Caudal peduncle length	26.5	25.5–26.6	26.2±0.61
Caudal peduncle depth	6.6	6.0–6.6	6.4±0.35
Body depth at anus	14.0	12.9–14.7	13.9±0.91
Head length	19.3	19.0–19.3	19.1±0.15
Head width	17.0	15.1–17.0	16.4±1.10
Head depth	13.0	12.0–13.0	12.7±0.58
%HL			
Snout length	61.0	60.5–61.1	60.9±0.32
Interorbital distance	27.0	27.0–31.5	28.6±2.54
Eye diameter	7.5	7.5–8.3	7.9±0.40
Nasal barbel length	20.0	19.9–25.9	21.9±3.44
Maxillary barbel length	45.5	45.5–54.6	48.8±5.01
Inner mandibular barbel length	17.5	17.5–21.5	19.2±2.08
Outer mandibular barbel length	28.0	23.4–28.7	26.7±2.88

Distribution. Known from the Mewa Khola (River), which is part of the Tamur River drainage (Fig. 2). The Tamur River is an eastern tributary of the Kosi River, Nepal's largest river, which flows through eastern Nepal and into the Ganges River in India.

Etymology. From the Latin *crassus*, meaning thick, and *cauda*, meaning tail, in reference to the deep caudal peduncle of this species. Used as an adjective.

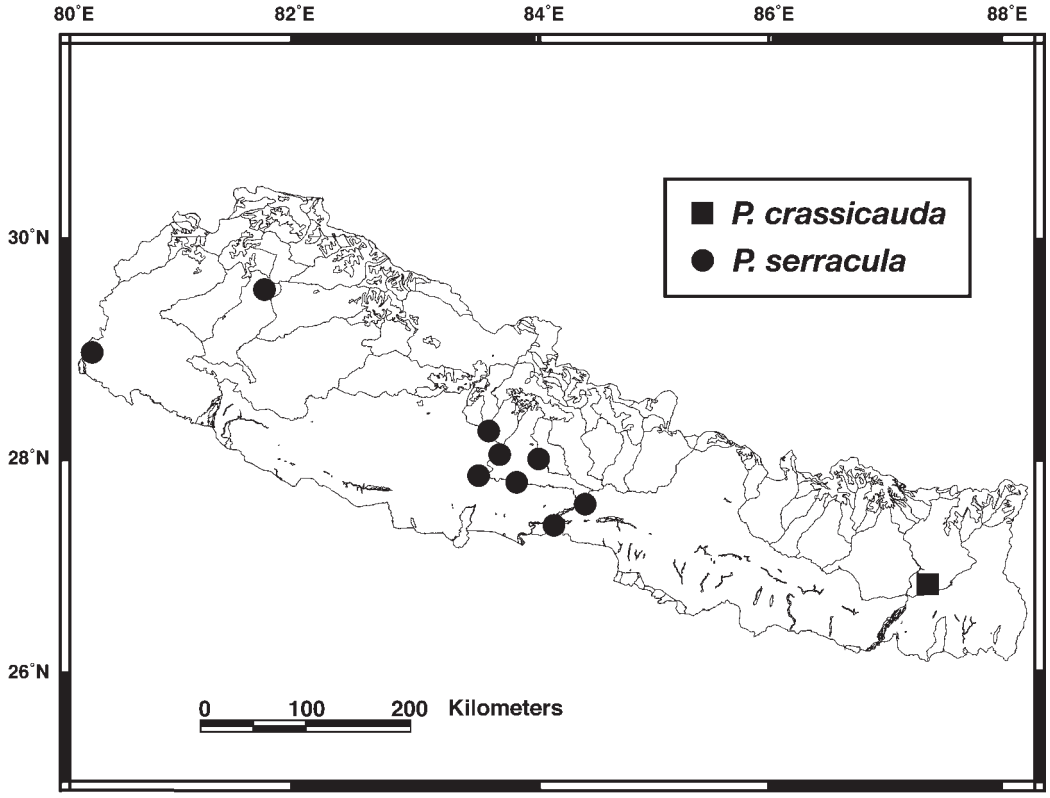

FIGURE 2. Map showing distribution of *Pseudecheneis crassicauda* and *P. serracula*.

***Pseudecheneis serracula* sp. nov.** (Fig. 3)

Pseudecheneis sulcatus (non M'Clelland, 1842) Edds, 1986a: 6; 1986b: 18; 1987: 11; 1993: 59; Shrestha, 1981: 197, Fig. 91 (in part); 1994: 62, Fig. 97 (in part).

Type material. Holotype: KU 29554, 153.2 mm SL; Nepal: Mugu/Bajura, Jhugala, Karnali River, purchased at Jhugala, 29°31'18.0"N 81°46'48.0"E; D. Edds, 25 September 1996.

Paratypes: BMNH 1985.9.16.50–51 (2), 48.0–48.2 mm SL; Nepal: Narayani River, Chitawan National Park; Edinburgh University, November 1984–February 1985. KU 28669 (5), 41.5–56.5 mm SL; Nepal: Kanchanpur, Brahamadev, Mahakali River at Brahamadev, 29°4'54.1"N 80°8'30.1"E; D. Edds, 24 February 1996. KU 29038 (1), 58.0 mm SL; Nepal: Gulmi/Syangja, Kali Gandaki River at Ridi Bazar; 27°56'6.0"N 83°26'30.1"E; D. Edds, 21 May 1996. KU 35545 (2), 48.0–95.3 mm SL; Nepal: Tanahun, Khairenitar, Seti River at Khairenitar, 28°2'0.0"N 84°4'0.0"E; D. Edds, 15 June 1996.

OSUS 15703 (4), 31.6–59.3 mm SL; Nepal: Syangja, Kali Gandaki River at Nimaa; D. Edds, 4 May 1985. OSUS 15718 (9), 34.1–75.5 mm SL; Nepal: Gulmi/Syangja, Kali Gandaki River at Ridi Bazar; 27°56'6.0"N 83°26'30.1"E; D. Edds, 22 May 1984. OSUS 15729 (3), 53.5–59.6 mm SL; Nepal: Baglung, Kali Gandaki River at Sumsaa Ghat (Binamaare); D. Edds, 25 May 1984. OSUS 15736 (6), 19.8–54.4 mm SL; Nepal: Myagdi, Kali Gandaki River at Simaa; D. Edds, 27 May 1984. OSUS 16340 (1), 79.5 mm SL; Nepal: Chitawan, Narayani River at Narayanagarh, upstream from irrigation office; D. Edds, 10 February 1985. OSUS 16609 (1), 22.2 mm SL; Nepal: Chitawan, Narayani River at Amaltaari Ghat; D. Edds, 5 April 1985. OSUS 16637 (15), 63.0–130.5 mm SL; Nepal: Chitawan, Narayani River at Narayangarh, upstream from irrigation office; D. Edds, 19 April 1985. OSUS 16695 (1), 62.3 mm SL; Nepal: Syangja, Kali Gandaki River at Nimaa; D. Edds, 2 May 1985. OSUS 17179 (1), 80.0 mm SL; Nepal: Syangja, Kali Gandaki River at Nimaa; D. Edds, 6 January 1986.

Diagnosis. *Pseudecheneis serracula* is distinguished from *P. paviei* and *P. sympelvica* in having an elongate body with 36–38 vertebrae (vs. short body with 33–35 vertebrae) and from *P. sympelvica* in having separate (vs. fused) pelvic fins. It differs from other congeners in having strongly elevated neural spines of the last 2–3 preanal and first 6–7 postanal vertebrae (vs. neural spines of corresponding pre- and postanal vertebrae gradually increasing in height; Fig. 4) and, except for *P. immaculata*, in having a longer adipose-fin base (at least 2.0 times length of anal-fin base vs. 1.5–2.0 times; 26.8–30.4% SL vs. 17.8–24.3). *Pseudecheneis serracula* is further distinguished from *P. immaculata* in the presence (vs. absence) of pale spots on the body, and from *P. sulcata* in having pelvic fins that reach (vs. do not reach) the base of the first anal-fin ray.

Description. Morphometric data as in Table 2. Head and abdominal region narrow and strongly depressed. Dorsal profile rising gently from tip of snout to origin of dorsal fin, then almost horizontal or sloping very gently ventrally to end of caudal peduncle. Ventral profile horizontal to anal-fin base, then sloping very gently dorsally to end of caudal peduncle. Caudal peduncle long and moderately compressed. Anus and urogenital openings located at posteriormost extent of pelvic fin. Skin smooth, tuberculate in some areas. Lateral line complete and midlateral. Vertebrae 18+18=36 (14), 19+17=36 (1), 18+19=37 (14), 19+18=37* (19), 19+19=38 (3) or 20+18=38 (1).

Head acutely rounded when viewed from above. Gill openings moderate, extending from posttemporal region to base of first pectoral-fin element. Head covered with thick, tuberculate skin. Ventral surface of head with unculiferous collar on distal margin of branchiostegal membrane immediately anterior to thoracic adhesive apparatus.

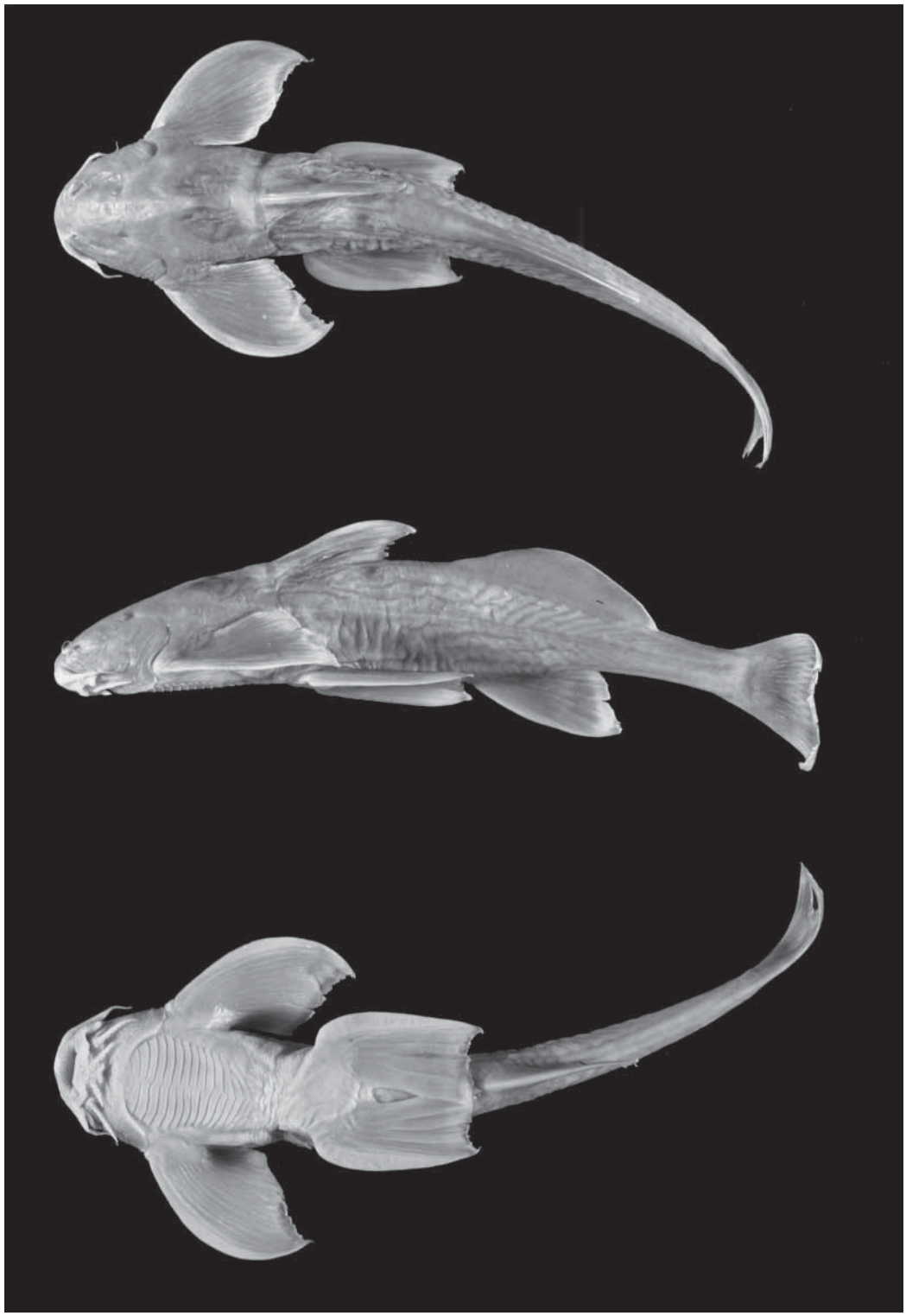

FIGURE 3. *Pseudecheneis serracula*, KU 29554, holotype, 153.2 mm SL; Nepal: Karnali River. Dorsal, lateral and ventral views.

TABLE 2. Biometric data for *Pseudecheneis serracula* (n=52)

	Holotype	Range	Mean±SD
%SL			
Predorsal length	34.3	32.7–38.4	36.1±1.40
Preanal length	57.4	34.5–63.5	59.3±6.61
Prepelvic length	35.6	35.6–41.0	37.7±1.57
Prepectoral length	16.8	14.3–20.8	16.9±1.66
Length of dorsal-fin base	11.6	11.1–14.4	12.7±1.02
Anal-fin length	13.3	12.3–15.6	13.7±0.94
Pelvic-fin length	23.4	20.4–23.8	21.7±0.87
Pectoral-fin length	29.1	24.5–30.9	27.9±1.71
Caudal-fin length	17.9	17.9–26.9	21.1±2.55
Length of adipose-fin base	30.4	26.8–30.4	28.7±1.07
Dorsal to adipose distance	15.2	10.0–17.3	14.7±2.10
Post-adipose distance	16.0	12.9–17.0	15.1±1.09
Caudal peduncle length	30.6	25.2–30.6	27.1±1.34
Caudal peduncle depth	4.9	4.2–5.7	4.7±0.53
Body depth at anus	15.5	13.1–20.0	15.7±1.79
Head length	18.9	18.5–20.6	19.5±0.62
Head width	18.5	14.9–19.8	17.5±1.15
Head depth	13.3	11.2–15.2	13.3±1.19
%HL			
Snout length	66.9	62.2–68.6	65.3±1.78
Interorbital distance	27.2	25.3–35.4	29.7±3.09
Eye diameter	9.1	9.1–12.2	10.7±0.89
Nasal barbel length	32.8	18.8–36.4	26.2±5.05
Maxillary barbel length	62.1	43.6–70.1	57.8±8.44
Inner mandibular barbel length	22.4	15.4–46.7	21.3±7.50
Outer mandibular barbel length	37.9	16.8–37.9	30.5±6.23

Thoracic adhesive apparatus consisting of 13–18 transverse ridges (laminae) separated by grooves (sulcae); ridges frequently not meeting at midline of adhesive apparatus. Adhesive apparatus extending from immediately posterior to collar on distal margin of branchiostegal membrane to level of last pectoral-fin ray.

Barbels flattened, and in four pairs. Maxillary barbel with ventral surface densely covered with papillae, and pointed tip; barbel extending about two-thirds of distance

between its base and base of first pectoral-fin element. Distal half of barbel attached to snout via large, thin flap of skin. Nasal barbel with small flap of thin skin fringing posterior margin and extending midway to distance between posterior nares and anterior orbital margin. Inner mandibular-barbel densely covered with papillae; origin close to midline, extending to collar on distal margin of branchiostegal membrane. Outer mandibular barbel originates posterolateral of inner mandibular barbel, extending to level of anterior orbital margin. Eye small and almost rounded, subcutaneous and located on dorsal surface of head.

Mouth inferior, with moderately broad, thin papillate lips. Rictal lobe large and papillate. Premaxillary tooth band not exposed when mouth is closed. Premaxillary teeth short and conical, arranged in irregular rows on a moderately large quadrangular patch. Dentary teeth long, thin and somewhat rounded at tip; arranged in irregular rows on two separated, roughly triangular patches.

Dorsal-fin origin located at point through anterior third of body. First and second dorsal fin-ray elements not ossified, bearing i,5 (1), i,5,i (4) or i,6* (47) rays, and fin margin straight. Adipose fin with moderately long base, at least 2.0 times anal-fin base length; located in middle third of postdorsal region. Adipose fin margin gently convex; posterior end deeply incised. Caudal fin forked, with i,7,7,i (1), i,7,8,i* (47), i,8,7,i (1) or i,8,8,i (3) principal rays; procurrent rays symmetrical and extend only slightly anterior to fin base. Anal fin with short base extending less than half of adipose fin-base length and iv,7 (15), iv,8 (22), v,6 (1), v,6,i (7) or v,7* (7) rays. Anal fin margin almost straight.

Pelvic-fin origin at vertical through second or third dorsal fin-ray base. Pelvic fin greatly enlarged, extending to base of first anal-fin ray. Anterior fin margin strongly convex, first element broadened and with regular striae on ventral surface; with i,5 (52) rays. Pectoral fin greatly enlarged and with convex anterior margin, reaching to just beyond pelvic-fin base. First element not ossified, broadened and with regular striae on ventral surface; fin with i,12 (2), i,13* (40) or i,14 (10) rays.

Coloration. In 70% ethanol and 45% isopropanol: chestnut brown on dorsal and lateral surfaces of head and body, fading to very light brown on ventral region. Dorsal surfaces of head and body with distinctive series of small very light brown spots and bands: one ovate spot on base of first dorsal-fin ray, and another pair on each side of body immediately posterior to last dorsal-fin ray; one band on each side of body at adipose-fin origin, and another on caudal peduncle at base of caudal fin. Dorsal and anal fins hyaline, with brown base and brown subdistal band; brown coloration of base and subdistal band connected to each other at anterior third of fin. Adipose fin light brown, with lighter color around distal edge, especially at posterior end of fin. Caudal fin brown, with hyaline distal margin. Dorsal surfaces of pectoral and pelvic fins brown, ventral surfaces light yellow. Maxillary and nasal barbels brown dorsally and light yellow ventrally.

Distribution. Presently known only from rivers of the Middle Hills and Tarai (lowlands) of western (Karnali drainage) and central (Gandaki drainage) Nepal, in and at

the base of foothills of the Himalayas (Fig. 2). The Karnali (= Ghaghara or Gogra in India) is a major tributary of the Ganges River in India. The Mahakali (= Sarda in India) forms the western border of Nepal with India, and is a tributary to the Ghaghara in India. The Seti and Kali Gandaki are tributaries to the Trisuli, which becomes the Narayani (= Sapta Gandaki) in Nepal. The Narayani (= Gandak in India) is a major tributary of the Ganges River in India.

Habitat and ecology. This species was captured exclusively in riffles, which were typically broad and shallow, well-oxygenated, and had swift water velocities over rocky substrate (Fig. 4). Habitat assessment for seven of these areas showed mean water depths of 10 cm (SE = 0.3), mean water velocities of 0.7 m/s (SE = 0.08), minimum dissolved oxygen of 8 mg/L, and pH from 8.0 to 8.75. Substrate was primarily cobble (ca. 64–256 mm) (68%, SE = 12.0) and pebble (ca. 32–64 mm) (17%, SE = 6.8).

FIGURE 4. Type locality of *Pseudecheneis serracula* (Karnali River in the vicinity of Jhugala).

Pseudecheneis serracula feeds on aquatic insects, including caddisflies (Edds, 1987). Species associates in our collections included *Crossocheilus latius* (Cyprinidae), *Garra annandalei* (Cyprinidae), *G. gotyla* (Cyprinidae), *Schizothoraichthys progastus* (Cyprinidae), *Schizothorax richardsonii* (Cyprinidae), *Botia almorhae* (Cobitidae), and *Glyptothorax* cf. *pectinopterus* (Sisoridae). In the Seti River, *P. serracula* was found syntopically with *P. sulcata*. Local fishermen report that *P. serracula* (local name = kabre) ascends the Kali Gandaki River to ca. 1000 m asl during monsoon (Edds, 1986b), suggesting these fish may breed in upper reaches of the river, then migrate downstream following spawning season.

Etymology. From the Latin *serraculum*, meaning rudder, in allusion to the large adipose fin of this species. Used as a noun.

Discussion

Pseudecheneis intermedius Chu, 1982 is here considered a junior synonym of *P. paviei*. *Pseudecheneis intermedius* was distinguished from *P. paviei* by the relative position of the adipose and anal fins (Chu, 1982). Our examination of material identified as *P. intermedius* and *P. paviei* from northern Vietnam and southern China revealed no significant differences in the relative position of the adipose and anal fins, nor could we find any other morphological or biometric differences to distinguish between the two. Chu et al. (1990) indicated that the outline of the snout tip can be used to distinguish between the two species, but this is a variable character that changes with the position of the maxillary barbels (i.e. whether they are projected sideways or pressed against the head) and is therefore not considered a useful diagnostic feature here. We tentatively follow Zhou & Chu (1992) in considering *P. tchangi* (Hora, 1937) a junior synonym of *P. sulcata*. The status of *P. tchangi* is being investigated in a separate study by HHN.

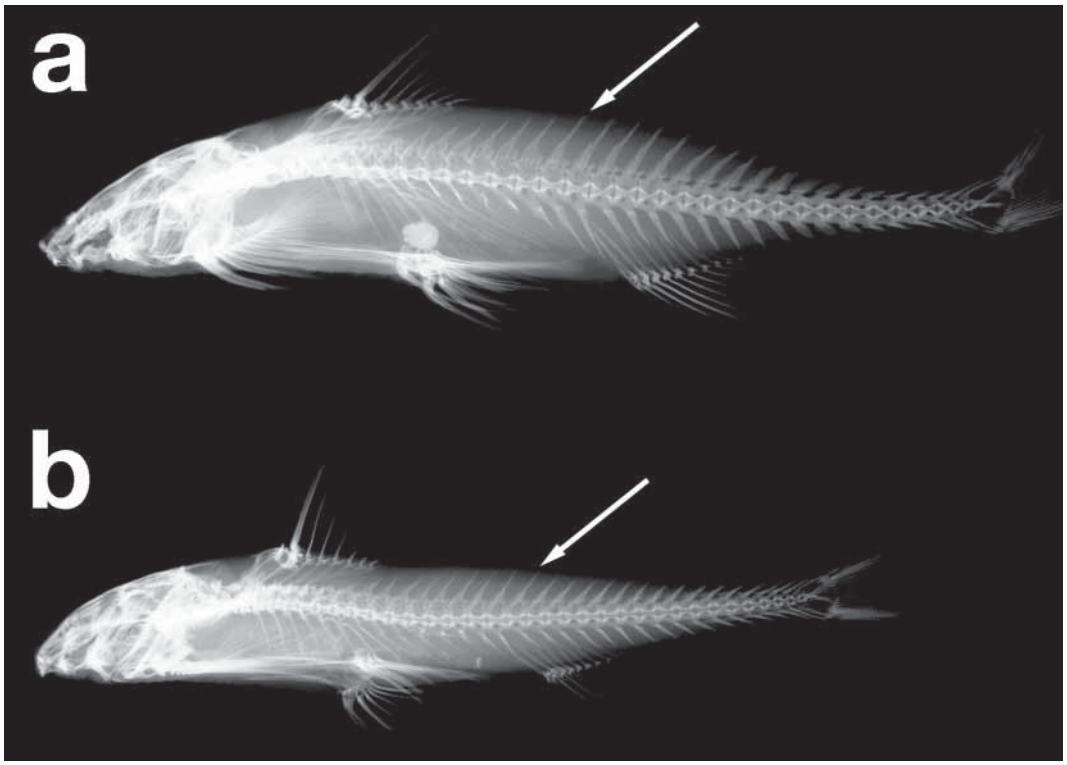

FIGURE 5. Radiographs showing differences in relative heights of neural spines in: a. *Pseudecheneis serracula*, paratype, OSUS 15718, 65.0 mm SL; b. other congeners (*P. sulcata*, KU 29084, 55.8 mm SL illustrated). Arrows indicate adipose-fin origin.

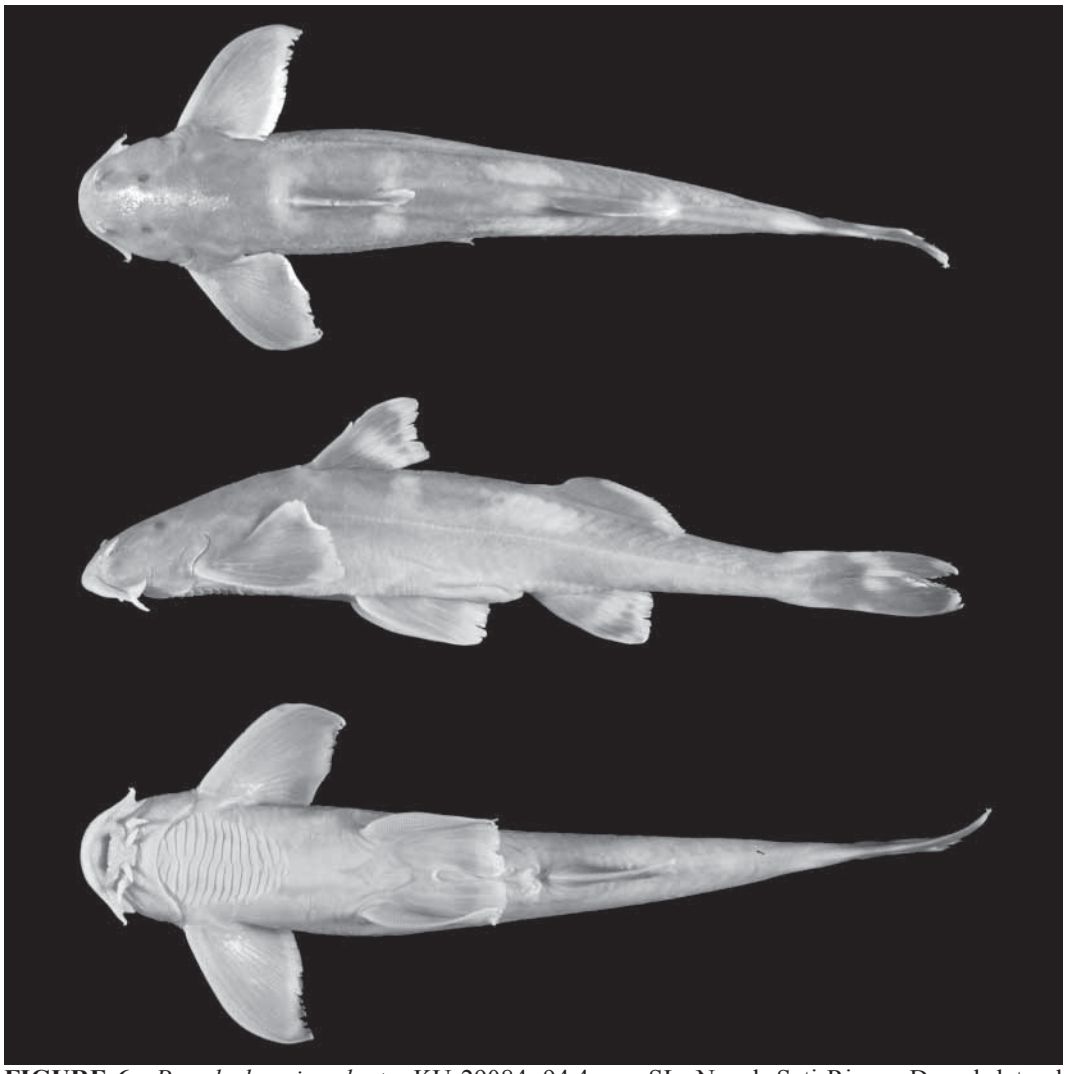

FIGURE 6. *Pseudecheneis sulcata*, KU 29084, 94.4 mm SL; Nepal: Seti River. Dorsal, lateral and ventral views.

The relative height of the neural spines readily distinguishes *P. serracula* from its congeners, especially *P. sulcata* (which occurs sympatrically and syntopically with it; see below). The difference is readily apparent in radiographs (Fig. 5), but even without recourse to such techniques, it is possible to see a difference in external morphology caused by the difference in height of the neural spines. The increase in body depth in the region between the dorsal and adipose fins caused by the neural spines in *P. serracula* imparts a somewhat hunched appearance compared to *P. sulcata* (compare Figs. 3 and 6).

Biplots of the length of the adipose-fin base for *P. serracula* vs. *P. sulcata* (Fig. 7) and caudal peduncle depth against SL for *P. crassicauda* vs. *P. serracula* and *P. sulcata* (Fig. 8) show that the regression lines are significantly different (ANCOVA; $P<0.05$). Likewise, biplots of eye diameter against SL for for *P. crassicauda* vs. *P. serracula* and *P. sulcata* (Fig. 9) are also significantly different (ANCOVA; $P<0.05$).

TABLE 3. Key distinguishing characters for *Pseudecheneis* species occurring in the Ganges River drainage

	P. crassicauda n=3	*P. serracula* n=52	*P. sulcata* n=30
Pelvic fins reaching base of first anal-fin ray	Yes	Yes	No
Pre- and post-anal neural spines strongly elevated	No	Yes	No
Caudal peduncle depth (% SL)	6.0–6.6	4.2–5.7	4.0–5.3
Length of adipose-fin base (% SL)	20.3–24.3	26.8–30.4	17.8–24.3
Eye diameter (% HL)	7.5–8.3	9.1–12.2	8.8–12.8

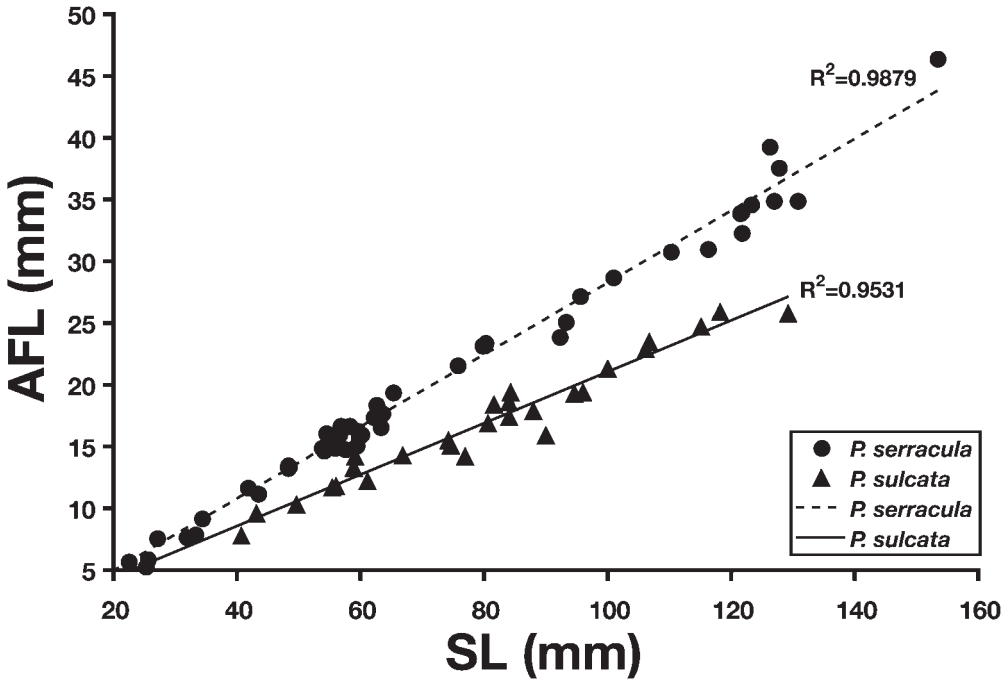

FIGURE 7. Biplot of length of adipose-fin base (AFL) against standard length for *Pseudecheneis serracula* and *P. sulcata*.

Pseudecheneis serracula was found syntopically with *P. sulcata* in the Seti River (the differences among the three species of *Pseudecheneis* known from the Ganges River drainage are highlighted in Table 3). Sisorid congeners occurring syntopically have been noted in several genera, e.g. *Bagarius, Gagata, Glyptothorax*, *Nangra* (DeWitt, 1960; Roberts, 1983; Edds, 1993; Roberts & Ferraris, 1998). It is common to find coexisting mixed-species groups of related fishes (Matthews, 1998), although hypotheses of resource partitioning (e.g. Zaret & Rand, 1971; Werner et al., 1977) would predict otherwise. Matthews (1998) suggested that fishes in heterospecific schools may gain information or other benefits. Such groupings might increase foraging efficiency or enhance detection

and avoidance of predators (Boucher et al., 1982; Allan, 1986; Allan and Pitcher, 1986; Pitcher, 1986). Gorman (1988) reported feeding associations between two species of *Notropis* (Cyprinidae), and Greenberg (1991) noted similar interactions among three species of *Percina* (Percidae). Mendelson (1975) concluded that multispecific schooling by four species of cyprinids might gain them anti-predator benefit. Moyle & Li (1979) and Allan (1986) suggested that rare fish species might benefit by hiding in groups of one or more other species that were more abundant. A few fishes enter into more complex symbioses via nest associations, some of which may be mutualistic (Matthews, 1998).

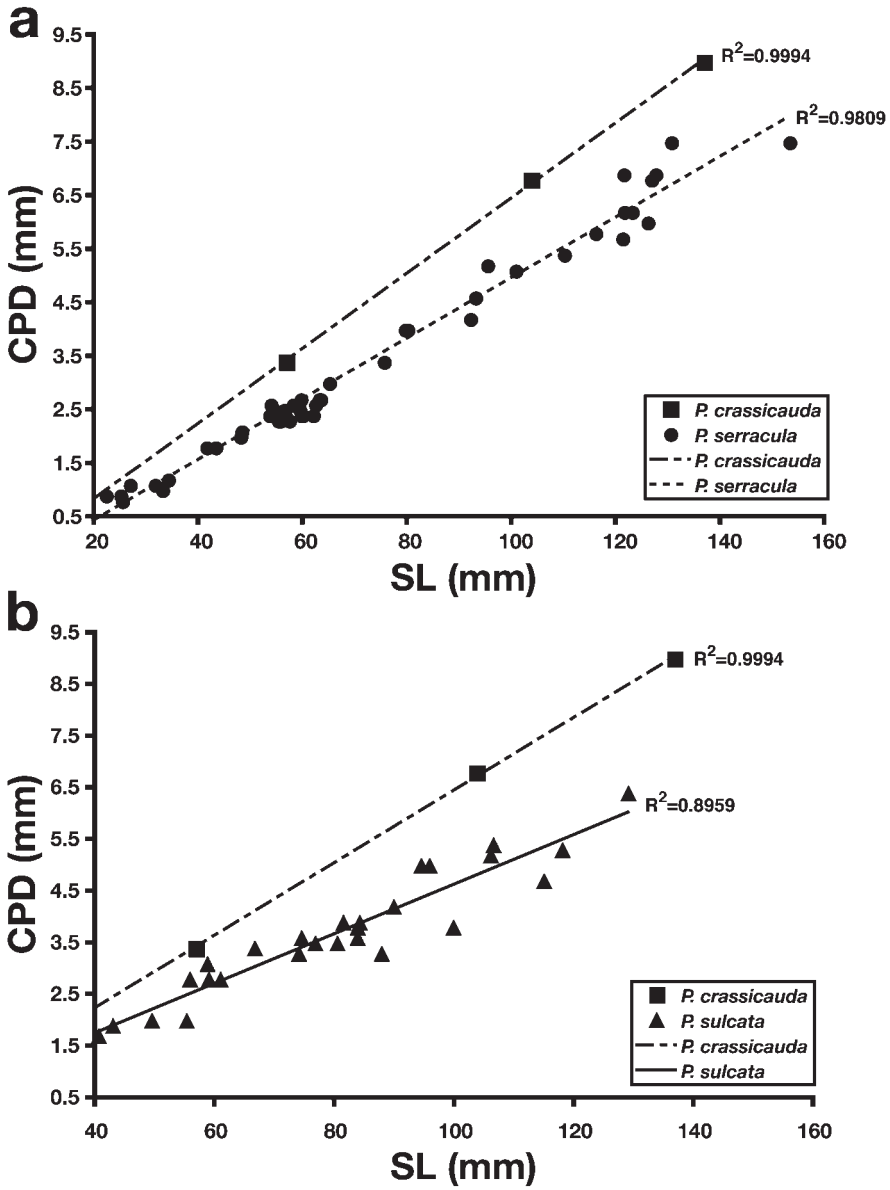

FIGURE 8. Biplot of caudal peduncle depth (CPD) against standard length for: a. *Pseudecheneis crassicauda* and *P. serracula*; b. *P. crassicauda* and *P. sulcata*.

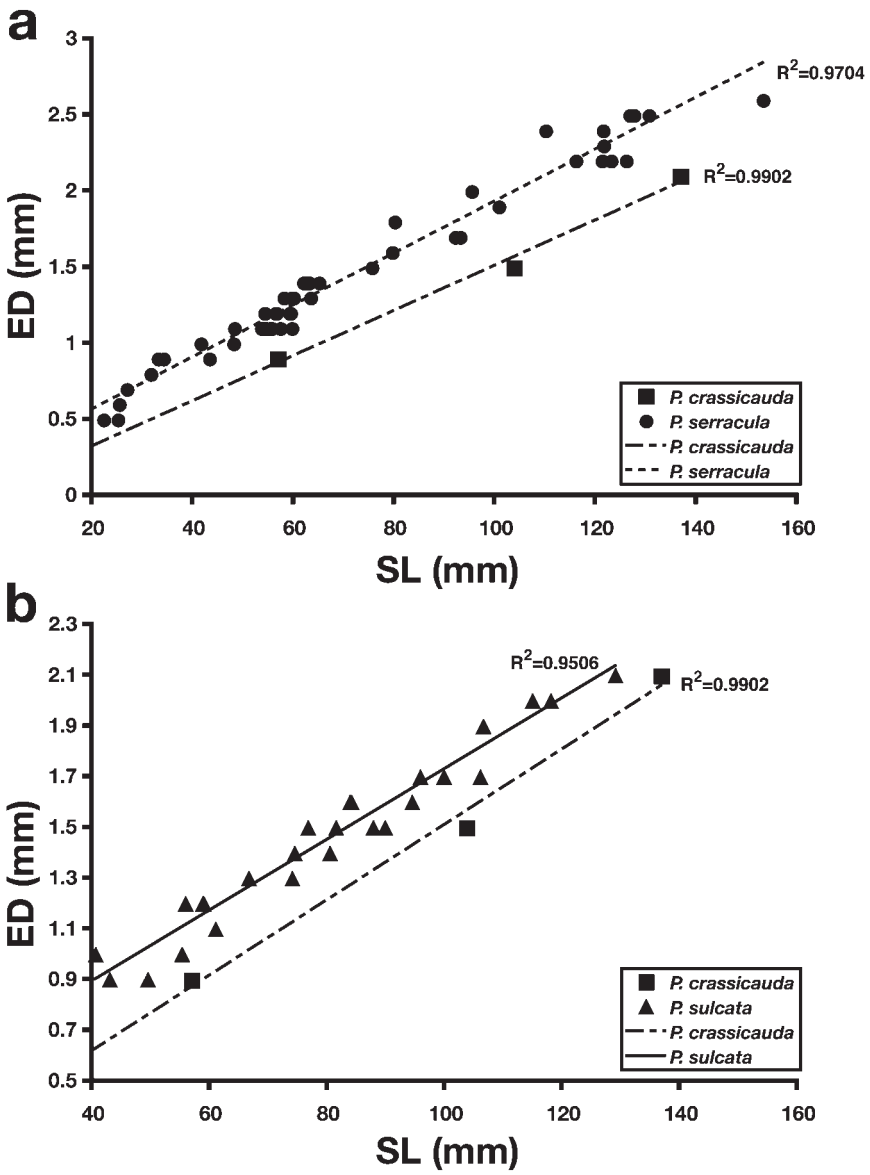

FIGURE 9. Biplot of eye diameter (ED) against standard length for: a. *Pseudecheneis crassicauda* and *P. serracula*; b. *P. crassicauda* and *P. sulcata*.

It is possible that the material we identify as *P. sulcata* from the Seti River is not conspecific with *P. sulcata* s. str., given that *Pseudecheneis* species appear to have restricted distributions (they are not found below elevations of ca. 150 m asl) and that the type locality of *P. sulcata* is in the tributaries of the Brahmaputra River in the Khasi Hills, India, a considerable distance to the southeast. A separate study by HHN is examining variation in *P. sulcata* throughout its range, and will include a redescription of the species and discussion of its diagnostic characters.

Comparative material

Pseudecheneis immaculata: BMNH 1987.9.17.5 (1 paratype), 80.9 mm SL; China: Yunnan, Deqin County, Liudongjiang.

P. paviei: BMNH 1987.9.17.24 (1 paratype of *P. intermedius*), 55.5 mm SL; China: Yunnan, Jingdong County, Dongbao. BMNH 2003.2.9.2–3 (2), 51.1–51.2 mm SL; China: Yunnan, Jingdong County, Yuanjiang drainage. MNHN 1935-0042 (1), 47.0 mm SL; Vietnam: Nghia Lo.

P. sulcatoides: CMK 5611 (3), 19.5–87.5 mm SL; China: Yunnan, Yangbi River from its confluence with Er-Hai River to about 20 km upstream of Yangbi.

P. sulcata: BMNH 1870.11.30.56 (3), 99.8–129.0 mm SL; BMNH 1889.2.1.27182719 (2), 60.9–89.8 mm SL; India: Meghalaya, Khasi Hills. BMNH 1928.9.17.5 (1), 83.8 mm SL; India: Meghalaya, Khasi Hills, Nong Priang stream. CAS 44188 (3), 45.5–62.1 mm SL: Nepal: Mahesh Khola, 24–32 km WNW of Kathmandu, on the road to Pokhara. KU 29084 (3), 55.8–94.4 mm SL; KU 29629 (6), 40.5–84.1 mm SL; Nepal: Tanahun, Khairenitar, Seti River, 28°2'0.0"N 84°4'0.0"E. UMMZ 243677 (10) 46.6–118.1 mm SL; India: West Bengal, Rishi Khola (River) at Rishi (on W Bengal-Sikkim border), 27°9'56.0"N 88°38'7.0"E. ZMA 121.861 (1), 87.8 mm SL; India: Meghalaya, Khasi Hills. ZMA 121.862 (1), 55.2 mm SL; India: Meghalaya, Nong Priang stream below Cherrapunji.

P. sympelvica: CMK12257 (3), 54.6–55.4 mm SL; Laos: Khammouan Province, Nam Theun, waterfall about 7 km downriver of NT2 dam site, 18°1'40"N 104°58'54"E. CMK 15231 (1), 62.4 mm SL; Laos: Xiangkhouang Province, Nam Ngum, rapids downstream of Ban Latbouak, 19°36'20"N 103°14'28"E. UMMZ 241107 (1), 43.7 mm SL; Laos: Luang Prabang Province, Nam Khan at Keng Noun (rapids), 10 km E of Luang Prabang.

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